

## SOLUBILITY

Solubility is the susceptibility of a rock to being dissolved. The solubility of any particular rock is dependent on the minerals that constitute the rock as well as the liquid that may dissolve these minerals. This activity demonstrates this important interdependence.

**Directions:** Review the activity, then answer the following questions before performing the experiments.

### Purpose:

What is the purpose of performing this experiment?

*(The purpose of this activity is to show that the solubility of a rock depends on its mineral constituents and the liquid that may dissolve it.)*

### Hypothesis:

State your hypothesis regarding the outcome of this experiment.

*(Answers will vary, but encourage students to be specific.)*

### Materials:

sodium chloride (NaCl — table salt)  
graduated cylinders (50 and 100mL)  
distilled water  
3 clear glass containers (vials, beakers, etc.)  
salts for making artificial sea water  
anhydrous isopropyl alcohol (>99% pure)  
laboratory stirring rods (or coffee stirrs)  
balance (capable of weighing as little as 0.1 gram)  
glassware for mixing sea water  
grease pen or pen and stick on labels

### Procedure:

1. Make artificial Great Salt Lake water by dissolving 20 grams (0.7 ounces) of NaCl in 100 milliliters (0.2 pints) of distilled water. (Stir until all the salt goes into solution.)
2. Weigh out 3 separate 5-gram (0.2 ounces) samples of NaCl.

3. Measure 14 mL (0.03 pints) **each** of distilled water, artificial Great Salt Lake water, and anhydrous isopropyl alcohol into the 3 clear glass containers. Be sure to label each container.
4. Add 1 of the 5-gram (0.2 ounces) samples of NaCl to each liquid and stir. (Use a separate stirring rod for each container.)
5. Note the amount of any solid remaining in the container.

**Observations:**

Describe your attempt to dissolve the 5 gram (0.2 ounces) NaCl sample in each of the following:

Distilled Water:

*(NaCl sample should dissolve completely.)*

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Great Salt Lake Water:

*(About one half of the NaCl sample will dissolve.)*

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Anhydrous Isopropyl Alcohol:

*(Very little of the NaCl sample will dissolve.)*

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**Conclusion:**

1. Explain your results. Why do you think this happened?

*(NaCl is an ionic solid, soluble in polar liquids, like water. GSL water, already near saturation, is unable to dissolve as much NaCl as distilled water.)*

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2. Why did the experiment call for distilled water instead of tap water?

*(Distilled water contains no dissolved salts. Tap water, depending on your area of the country, may contain some salts which would lead to less NaCl solubility.)*

3. Anhydrous alcohol is alcohol that is essentially waterless. Why was it important to use “waterless” alcohol?

*(NaCl solubility is high in water. By using anhydrous alcohol we observe the behavior of NaCl in a pure, non-polar liquid.)*

4. How does this demonstration show that solubility depends on the properties of both the liquid and the solid?

*(NaCl is ionic and soluble in polar liquids like water. It is not soluble in non-polar liquids like alcohol. Solubility in water is limited by the salt content of the water.)*

5. Why is the solubility of a rock important in siting a repository?

*(As soluble minerals dissolve, they change the composition of the water by adding ions that compete for ion exchange sites. Further, dissolving minerals leave voids that increase porosity and may increase permeability.)*

6. Water, moving through a rock of uniform composition, will initially dissolve some minerals. As the water travels farther through the rock its ability to dissolve minerals decreases and eventually becomes zero. Why?

*(At the start of its journey, the water is undersaturated with respect to the minerals. As the water moves, it reacts with minerals but is continuously exposed to fresh minerals. At some point during its journey, the water becomes saturated with respect to each mineral and cannot dissolve more.)*